

Research Article

Surgical Treatment of Missed Monteggia Fracture-Dislocation in Children without Annular Ligament Reconstruction.

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Abstract

Background: A Monteggia fracture dislocation is not an uncommon injury, and the diagnosis can often be missed. Methods involving annular ligament reconstruction require postoperative immobilization and thus a delay in rehabilitation. The purpose of the present study is to evaluate the clinical and radiographic outcomes for the management of missed Monteggia fracture dislocation in children without annular ligament reconstruction. **Methods:** In a prospective study, 13 patients (eight girls and five boys) with a mean age of 5.9 years who presented with neglected Monteggia fracture dislocation, were treated surgically between June 2009 and September 2011. The mean time from the injury to the operation was 10 months. Eight patients were classified as Bado type I, and five as Bado type II. The procedure consisted of open reduction of a dislocated radial head followed by ulnar angulation–distraction osteotomy, and internal fixation, without reconstruction of the annular ligament. Boyd's approach was used. Postoperatively the patients were evaluated by Kim's elbow performance score. Cast immobilization with the forearm in neutral rotation was maintained for 7 weeks. **Results:** The mean follow up period was 22 months. All patients had regained painless function of the forearm, good range of elbow and forearm motion, and no recurrent dislocation or neurovascular injury were observed. The elbow score was excellent in nine cases and good in four cases. **Conclusion:** Both angulation and distraction of the ulna are required to allow the radial head to reduce. The reconstruction of the annular ligament was unnecessary, as all the radial heads were stable without such reconstruction.

Keywords: Missed Monteggia, annular ligament reconstruction and Ulna osteotomy

Introduction

The neglected Monteggia fracture dislocation is diagnosed several months after the injury when the patient complains of elbow pain, decreased elbow flexion, valgus deformity, or neurologic problems⁽¹⁾. If left untreated, the dislocated radial head loses its concave articular surface thereby limiting the range of motion. It also hampers the normal growth of the radius and gives rise to distal radioulnar instability⁽²⁾.

Monteggia fracture although not an uncommon injury but is commonly missed. Causes for misdiagnosis are rarity of the lesion and inadequate radiological / clinical examination. Single forearm bone fracture should be treated as fracture dislocation until proved otherwise⁽³⁾.

Injuries of the forearm and elbow in children must be carefully evaluated by the trauma / orthopedic surgeon in the initial treatment period. Monteggia fracture dislocation can be diagnosed easily if radiographic evaluation of elbow is done by radiocapitellar line and ulnar bow sign. One should be aware that a line drawn through the radial shaft and head should align with the capitulum in all views. If it does not, then the radial head is dislocated⁽⁴⁾.

The treatment of chronic Monteggia fracture dislocation remains controversial. Pain, angular deformity and a decreased range of motion of the elbow and forearm justify operative treatment in young children. The treatment has

included observation^(e), closed or open reduction of the radial head^(v) repair^(s) or reconstruction of the annular ligament⁽ⁱ⁾ and osteotomy of the ulna^(t), or radius, or both, to treat malunion⁽¹⁾.

The purpose of this study is to highlight the management of missed Monteggia fracture dislocation in children without annular ligament reconstruction.

Subjects and Methods

Between June 2009 and September 2011, thirteen patients – eight girls and five boys, with neglected (> 1 month or more postinjury) Monteggia's fracture dislocation were treated by open reduction of the dislocated radial head followed by ulnar angulation–distraction osteotomy, and internal fixation, without reconstruction of the annular ligament.

Patients who presented at least one month after injury were included in this study. Exclusion criteria were: patients with marked deformation of the radial head, associated fractures of the ipsilateral extremity, and open fractures. None of the patients had a history of previous elbow pathology or surgery, and none had been treated initially.

The right elbow was involved in seven patients and the left in six. The mean interval between the initial injury and the corrective surgery was 10 (range 1–18) months, and the mean age of the patients at the time of surgery was 5.9 (range 1–10) years.

The pre- and post-operative clinical assessment of all patients included assessment of the range of flexion and extension of the elbow, pronation and supination of the forearm and standard anteroposterior and lateral radiographs. Terminal 10–20° of flexion was restricted in five cases and three children had elbow flexion contracture of 10°. Pronation was mildly restricted in five cases. Details are given in (Table 1).

The radiographs were studied for congruency of the radio-capitellar joint, deformity of the radial head, the relative lengths of the radius and ulna, deformities of the radius and ulna and osteoarthritic changes. To aid in diagnosing a radial

head dislocation, a line can be drawn through the radial shaft extending through the radial head using an elbow radiograph. If the radial head is in its normal anatomic position, the line should align with the capitellum in all radiographic views, especially the lateral image⁽¹⁾ (Fig. 1). There were eight children with a Bado type I where the radial head had dislocated anteriorly; and five with a Bado type II injury, where the radial head had dislocated posteriorly⁽¹⁾ (Fig. 2).

Surgical technique

All patients were treated surgically using the same technique, as described below. The patients were placed in a supine position with the elbow semi-flexed and the forearm pronated on a conventional surgical table. Tourniquet use was optional. The posterolateral approach described by Boyd⁽¹⁾, where a single incision was used to expose the radio-capitellar joint and the ulna. All dense fibrous tissue interposed between the radial head and the capitulum of humerus was removed. A transverse osteotomy of the proximal metaphysis of the ulna was then performed using the same incision; and the angulation produced was in the opposite direction of the radial head displacement to achieve reduction of the radial head which could be reduced easily in all cases. The amount of angulation and distraction required to maintain the radial head in position was determined intra-operatively. The osteotomy site was provisionally fixed with a plate and two screws, one proximal and one distal to the osteotomy site, and the radio-capitellar stability was assessed in pronation and supination. The gap was maintained using a plate AO-ASIF and fixed with screws (Fig. 3). In none of the patients was it necessary to reconstruct the annular ligament. No case required radial osteotomy, temporary transarticular radio-capitellar wire stabilization, or neurolysis in any of the patients. In all cases the ulna angulation and length restoration was all that was required to maintain reduction of the radio-capitellar joint.

A long arm plaster splint was applied for 2 weeks with the elbow in 90° of flexion and the forearm in neutral rotation. At that point the children were encouraged to use the elbow as tolerated, and no formal physiotherapy was advised.

Radiographs were taken after cast removal and at follow-up to determine the congruency of the radio-capitellar joint and the presence of any deformity or arthritic changes and to detect any residual subluxation and healing of the ulnar osteotomy. All children were reviewed at four weekly intervals after cast removal for initial assessment of motion for three months; then at three-month intervals to assess the final function.

The mean follow up period was 22 months (18 - 25 months). At final follow-up, all patients were rated according to the functional elbow score devised by Kim⁽¹⁰⁾ (table 2), which takes account of four parameters, namely deformity, pain, range of motion, and function, which are weighted equally with a scale of 1 (worst) to 100 (best). Total elbow performance score was graded as excellent (90 or more points), good (80-90 points); fair (70-80 points); or poor (less than 70 points).

Results

The results are summarised in (Table 1). The mean follow-up period was 20 months (18 - 25

months). At the last follow-up, all patients were rated according to the functional elbow score devised by Kim⁽¹⁰⁾.

Elbow, wrist, and forearm motion was without pain, with a mean elbow flexion of 138.0° (range 110° - 150°) and a mean extension of 7.9° (range 0°-10°). Mean forearm pro-nation was 13° (range 0°-10°), and mean supination was 80° (80° - 90°).

There were no neurovascular complications, compartment syndrome, or implant failure. Two children had superficial wound infection which resolved with local dressing.

Radiographs at the latest review showed that the radial head was successfully reduced in all cases. In addition, no patient had any degenerative changes in the elbow joint. There was radiological union of all the osteotomies after 6 months of follow up.

According to Kim's scoring system (table 2) 8 elbows had excellent outcome (fig. 3), and 2 had a good result.

Table 1: Details of the results in the 13 patients

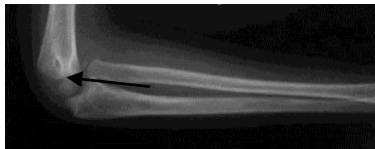
Case No.	Age (Year)	Gender	Interval From injury to operation (months)	Type of Bado Classification	Elbow flexion- extension (degree)		Elbow pronation-supination (degree)		Follow up (months)
					Pre-op	Follow-up	Pre-op	Follow-up	
1	9	M	17	I	130/0	110/10	80/80	80/80	20
2	6	F	12	I	100/10	140/0	40/90	60/90	24
3	10	M	9	II	120/10	120/10	80/80	80/80	18
4	9	F	1	I	100/0	100/0	80/90	80/90	20
5	7	M	14	I	100/10	100/10	80/90	80/90	24
6	9	F	2	I	140/0	140/0	00/80	60/80	18
7	8	F	10	II	140/0	140/0	60/80	40/90	22
8	8	M	18	II	140/0	140/0	40/80	00/80	20
9	6	F	10	I	100/0	100/0	90/90	90/90	22
10	8	F	12	I	110/0	120/0	80/80	80/80	22
11	9	M	2	II	140/0	100/0	90/90	90/90	24
12	7	F	10	II	120/0	130/0	80/90	80/90	22
13	6	F	11	I	140/0	100/0	80/80	80/80	24

Table 2: Kim's criteria

Criteria			
Deformity Score	No concern 20	Minor concern 10	Major concern 0
Pain Score	No pain 20	Mild - Intermittent 10	Activity limiting 0
ROM* Score	> 20.0 20	20.0-25.0 10	< 20.0 0
ADL** Score	No problem 20	With difficulty 10	Unable 0

ROM*: Sum of flexion-extension and pronation- supination arc.

ADL**: Activities of daily living (comb hair, feed self, open door knob, hold overhead, put shoes)



(A)

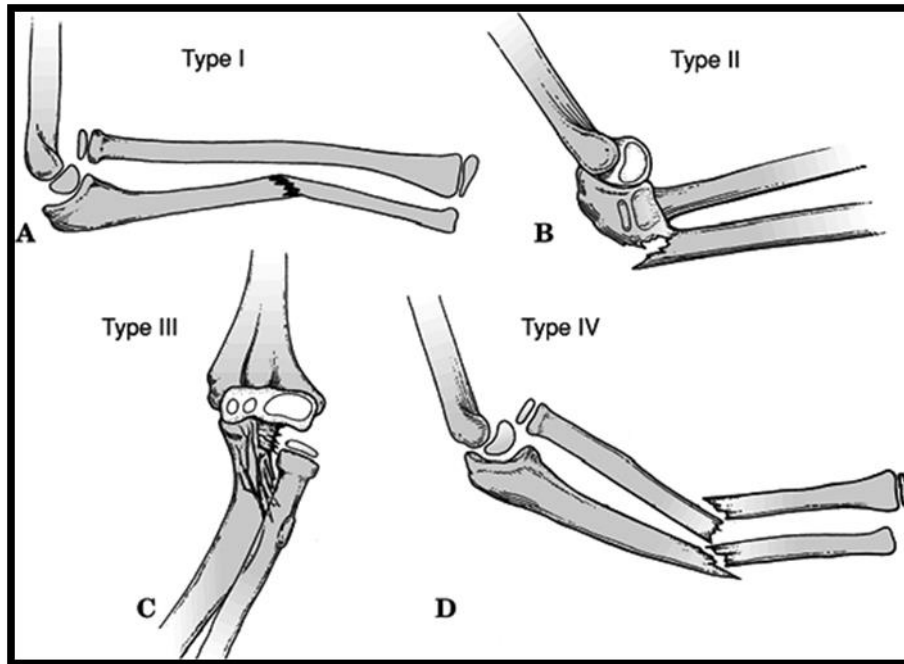


(B)

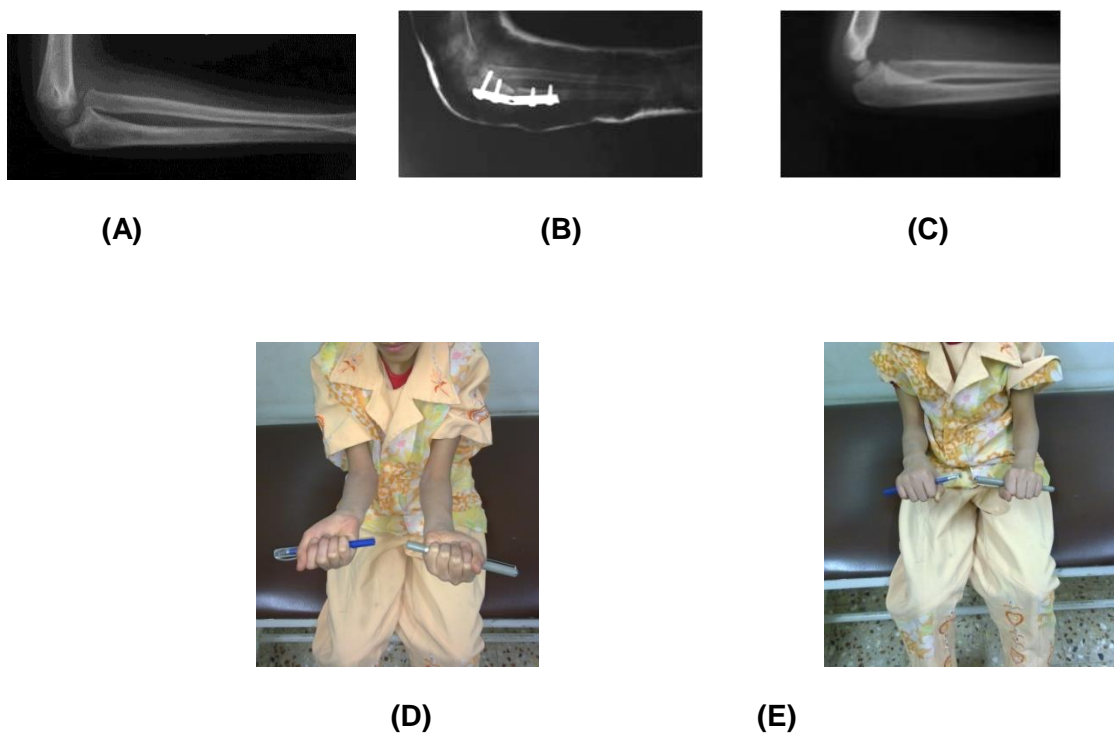
(Fig. 1)

(A) Anterior Monteggia fracture: the radial head does not align with the capitulum on the lateral view.

(B) Normal alignment restored.



(Fig. 2) Bado classification of Monteggia fracture dislocation¹³.



(Fig. 3)

- (A) Lateral radiograph showing old anterior Monteggia fracture dislocation.
- (B) Post-operative radiograph showing the angulation-distraction osteotomy of the ulna.
- (C) Follow up radiograph 1 year after implant removal.
- (D, and E) Excellent clinical, functional and cosmetic result.

Discussion

Bado⁽¹⁷⁾, using the eponym of Monteggia lesion, classified dislocation of the radiocapitellar joint associated with fracture of the ulna. The acute lesion is misdiagnosed frequently (16 to 33 per cent of the time) especially when there is associated plastic deformation of the ulna or a greenstick fracture^(8,17). Children have the unique characteristic of plastic deformation of bone, and that the ulnar fracture may not be present to alert one to the possibility of a radial head dislocation. Even when the correct diagnosis is made and a closed reduction is performed, the reduction is often lost (in approximately 20 per cent of patients), especially when the ulnar fracture is oblique. Unreduced dislocations of the radiocapitellar joint that are still present more than four weeks after the injury are considered chronic⁽¹⁷⁾.

Natural history of the disease is not benign if left untreated. It can lead to progressive valgus deformity, instability and decreased range of motion especially rotatory movements. Surgery was advised to achieve anatomic reduction of radial head, prevent progressive valgus instability and improve cosmetic appearance and range of motion. In cases of missed Monteggia fracture, the radio-capitellar articulation will progressively undergo dysplastic changes due to the lack of joint restraint, leading to well-documented long-term consequences that are unacceptable for the patient^(8,17). Thus, reduction of the radial head is necessary. The interval between the traumatic dislocation and reconstructive procedure could affect outcome since the dysplastic changes are not immediately correctable. However, since this dislocation occurs mainly in young patients who have a large amount of growth remaining, there is a high potential for remodeling⁽¹⁸⁾.

There is controversy regarding treatment of chronic Monteggia lesion with proponents for operative and non-operative treatment. Some authors recommend an open reduction of the radial head either with or without reconstruction of the annular ligament, combined or not with osteotomy of the radius or ulnar lengthening (at the apex of deformity or at proximal metaphysis) and with or without internal ulnar fixation and transcapitellar fixation of radial head^(9,10,19,20,21).

Missed Monteggia lesions result in ulnar malunion with anterior bowing which contribute to the persistence or irreducibility of the dislocated radial head. Some authors have reported anterior bowing of the ulna in 50% to 100% of post-traumatic dislocations^(10,22). Ulnar osteotomy is essential to correct ulnar deformity and attain anatomical and stable reduction of radial head. An oblique osteotomy, instead of a simple transverse one offers the advantage of angulating the ulna and gaining some length with preservation of bony contact⁽²²⁾. An osteotomy at the proximal ulna allows for greater likelihood of healing, and while angulation at the metaphyseal level has less effect on reduction, it permits a finer adjustment⁽²²⁾. Inoue and Shionoya⁽²²⁾ stressed the importance of ulnar angulation, as three of their six patients with simple osteotomy without angulation had persistent dislocation of the radial head. The current study proves that an ulnar angulation-distraction osteotomy provides for a more stable reduction of the radial head with better long-term results.

There is no consensus in the literature as to the type of fixation necessary to stabilize the osteotomy. Recommendations include internal or external fixation, or even no fixation^(13,22,23,24,25,26). It is doubtful if a simple ulnar osteotomy without internal fixation is appropriate since it is also necessary to lengthen the ulna⁽⁹⁾. All the osteotomies of the current study were internally fixed to decrease the risk of secondary displacement and to allow early mobilization. According to the tension band principle a posterior plate might have been a better choice. Internal fixation using a plate and screws is essential to maintain reduction until the full consolidation of ulnar osteotomy. Resection of the radial head should be reserved only for symptomatic cases in patients more advanced in years as an absolute exception, following skeletal maturation⁽¹³⁾.

External fixation and progressive correction, as previously described remains of little use in view of the fact that it is possible to achieve correction in one step⁽²⁷⁾. However, Hasler⁽²⁸⁾ found it easy to reconstruct the radiocapitellar joint, and to allow early resumption of functional exercises by using external fixation for the ulnar osteotomy with no annular ligament reconstruction.

Boyd's^(١٤) approach was used in all cases. It is the most appropriate for radial head dislocation and ulnar osteotomy in proximal metaphysis.

In the current study the oldest child with a successful outcome was aged ten years and the operation was performed nine months after injury. Neither the interval between injury and surgery nor the age at operation prejudiced the result at follow-up.

In the current study the reconstruction of the annular ligament was unnecessary, as all the radial heads were stable without such reconstruction, and this probably reflects the favourable results in this study. The decision to perform annular ligament reconstruction was based on the intra-operative stability of the radio-capitellar joint obtained after fixation of the ulnar osteotomy. Often, slight distraction with posterior angulation of the ulna would enhance the anatomical alignment of the radio-capitellar joint. This presumably occurs due to the tautness in the interosseous membrane, which provides adequate stability to the radial head in some cases. Ligament repair requires more extensive surgical exposure and post-operative immobilisation in a plaster cast. Furthermore, the additional dissection required to reconstruct the annular ligament might result in elbow stiffness, avascular necrosis of the radial head, heterotopic ossification, or radio-ulnar synostosis^(٢,٧,١٥,٢٨,٢٩,٣٠). When the radial head is deformed, stability cannot be fully restored by reconstruction of the ligament^(٧,٢٢,٣١).

The results of the current study support the use of surgical treatment for missed Monteggia fracture-dislocation in children and accord with the results published by other authors^(١٠,١٩,٢١). Indirect reduction of the radial head through ulnar osteotomy is the treatment of choice for these lesions in children.

Conclusions

- Early recognition of Monteggia lesion by adequate x-ray (two planes) including elbow and wrist joints, adequate clinical examination, high index of suspicion and early examination by an orthopedic surgeon can prevent the morbidity associated with chronic Monteggia lesions.

- Reconstruction of the annular ligament is not necessary if satisfactory re-orientation of the ulna is achieved in all planes.
- Osteotomy is usually necessary to lengthen the ulna and produce a stable radial head reduction.
- According to the results of the current study it seems that this procedure for the treatment of chronic Monteggia fracture results in excellent pain-free function and good motion of elbow, forearm, and wrist, with no pain or instability at the distal radioulnar joint in the short term. The long-term benefit of such treatment requires further observation.

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